BACKGROUND PAPER
ON
JOINT GLOBAL POSITIONING SYSTEM COMBAT EFFECTIVENESS
JOINT TEST AND EVALUATION
(JGPSCE JT&E)

SUBJECT: Joint Global Positioning System Combat Effectiveness Joint Test and Evaluation

PROGRAM SPONSOR: Office of Secretary of Defense, DD, DT&E/S&TS

BACKGROUND: Various studies conducted within the Department of Defense (DoD) point out that the economics and technologies to develop and field a credible GPS threat are within the grasp of virtually any nation. Therefore, any potential adversary could produce and field a significant threat to GPS quickly and inexpensively. In addition to the hostile jamming threat, there is growing interest in the impact of electromagnetic environmental effects (E3) such as EMI.

There is also an ever-increasing reliance on GPS in military systems, creating a potentially critical vulnerability for U.S. and allied warfighting should GPS be degraded. The problem is further compounded by the fact that reliance on GPS is subtle in some cases, for example, communications and data link systems that use GPS for timing synchronization. While dependence on GPS is growing at a rapid pace, there are indications that warfighters are not fully aware of GPS vulnerabilities and potential mission impacts. Areas of concern include precision weapons employment where GPS jamming can degrade precision weapon accuracy, resulting in an increase in collateral damage, fratricide, and high-cost weapon expenditures.

Interruption of GPS can deny warfighters a common time and position coordinate reference. The lack of common reference could lead to delays in finding targets, increased exposure to threats, missed engagements, and in the worst case — fratricide. There is little question that operational concepts such as all-weather, day-night precision engagement outlined in Joint Vision 2010 are jeopardized due to the denial or degradation of GPS.

The JGPSCE problem statement was derived from concerns expressed by the operational community:

"*Warfighters are increasingly reliant on GPS.*
The impact of the loss or degradation of GPS capabilities and the ability to operate despite that loss or degradation have not been systematically tested or evaluated in a joint operational environment."

PURPOSE: On 29 July 1999, the Office of the Undersecretary of Defense (OUSD), Director, Test, Systems Engineering and Evaluation (currently Director, Strategic and Tactical Systems [S&TS]), in cooperation with the Joint Chiefs of Staff and Services, chartered JGPSCE JT&E. The JGPSCE JT&E will consist of a series of test events over four and a half years focusing on the effectiveness of joint interdiction and reconnaissance missions when GPS is degraded by electronic warfare (EW) or electromagnetic interference (EMI). The JGPSCE Joint Test Force (JTF) will conduct test events on live ranges to collect data and answer the program issues. Test

events will focus on the impact of GPS vulnerabilities on precision engagement — one of the four operational concepts that are key to Joint Vision (JV) 2010.

Along with quantifying and qualifying the impact of GPS system vulnerabilities to EW and EMI, the JGPSCE JT&E will examine joint and multi-service tactics, techniques, and procedures (TTPs) and system-level mitigations that could improve or maintain combat capability in the face of GPS EW and EMI. The JGPSCE JTF will work hand-in-hand with Unified Commands and the Services to develop and test mitigation techniques that can be of immediate and lasting benefit to warfighters. While addressing operational issues, the JGPSCE JTF will develop a validated test methodology that can be used by the system acquisition and integration test communities to assess GPS vulnerabilities early in the acquisition cycle.

Three test issues emerged from the JGPSCE problem statement:

Issue 1: What is the impact of GPS vulnerabilities on the effectiveness of joint operational missions that require precision engagement?

Issue 2: What changes in joint TTPs or system level mitigation techniques improve or maintain joint operational mission effectiveness in the event of GPS EW and EMI?

Issue 3: What test methodologies can be employed to characterize GPS vulnerabilities in future acquisition and integration programs?

PROGRAM ORGANIZATION: The JGPSCE JTF reports to the Deputy Director, Developmental Test and Evaluation(DD, DT&E)/S&TS, OUSD, Acquisition, Technology and Logistics (AT&L). The United States Air Force is the lead Service providing facilities, support, and civilian personnel. Military personnel from all Services will participate on the JGPSCE JTF, augmented by a team of operationally and technically experienced contractor personnel. JGPSCE JTF headquarters is located at Kirtland Air Force Base, New Mexico, and maintains liaison with Joint Forces Command at Suffolk, VA.

TEST APPROACH: JGPSCE JT&E will conduct three phases of testing, implemented by four test events, each examining an increasing level of warfare. The three phases of warfare are: (1) Small Scale Contingency; (2) Limited Engagement; and (3) Major Theater War. Each level represents a major concern for DoD planners today, as well as presents unique problems in maneuver, engagement, and logistics/force protection. All are highly dependent on secure, high-speed communications.

In order to provide a manageable scope of testing, JT&E is limiting the evaluation to the arena of precision engagement of interdiction targets. This decision was taken for several reasons. First, the unified and component commands have expressed high interest in precision engagement. Second, precision engagement is one of the four operating concepts defined in Joint Vision 2020 giving JGPSCE a sound doctrinal base. Finally, interdiction (with supporting reconnaissance missions) are dependent on a sensor-to-shooter chain that is sensitive to accurate location and timing information provided by GPS

Each of the three test phases is designed to provide information relating to key information upon which warfighters can base subsequent decisions. Each phase will use jamming of GPS in the open air to be as realistic as possible. Each phase will look at the impact of GPS electronic warfare and electromagnetic interference by comparing baseline performance to performance after the electronic warfare and electromagnetic interference occurs. Each phase will also introduce mitigation techniques and procedures developed during test planning, and look at the ability of troops and commanders to operate in a GPS degraded or denied environment. Thus, each of the three phases will be immediately useful to theater commanders and DoD.

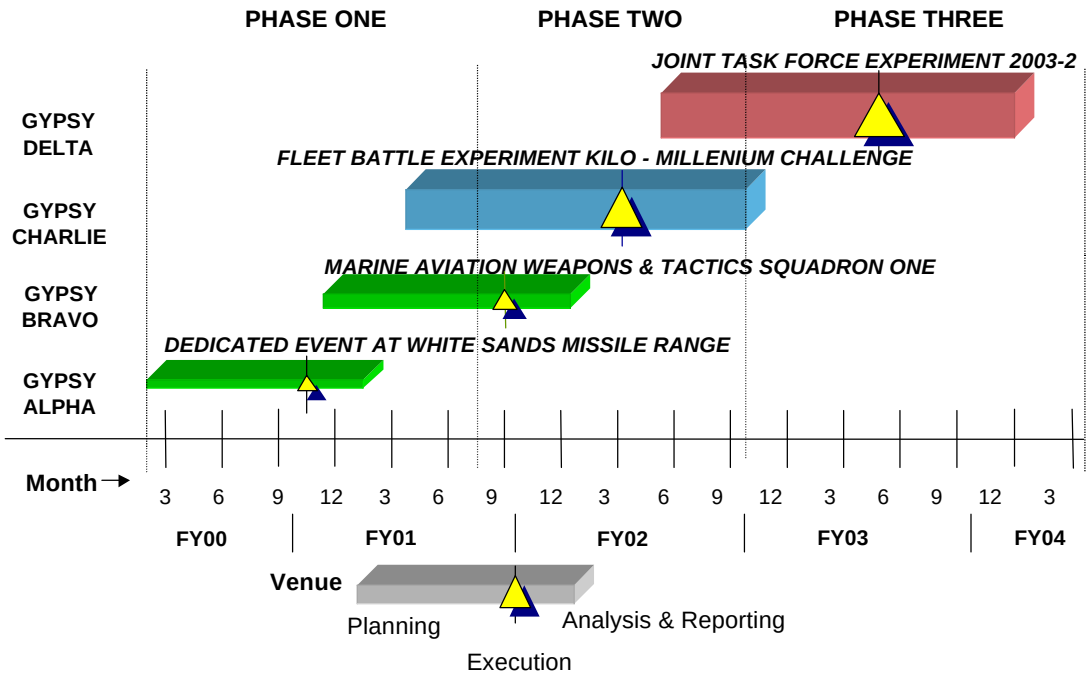
Phase 1 testing will consist of two live tests events, GYPSY ALPHA and GYPSY BRAVO, at the tactical level of warfare. These tests will focus on determining GPS electronic warfare and electromagnetic interference vulnerabilities and mitigations for few-on-few engagements during small scale contingencies. Each of the two live test in Phase 1 will concentrate on portions of the sensor-to-shooter architecture.

Phase 2 testing will consist of one live test event, GYPSY CHARLIE. The focus of this test will be on integrated system-of-systems tactical-level mission performance and integrated system-of-systems operational-level mission performance during limited engagement operations.

Phase 3 testing will consist of a single test, GYPSY DELTA, which will evaluate integrated tactical and operational level systems and warfighters performing missions during an major theater of war scenario.

The JGPSCE JTF test schedule is as follows:

JGPSCE JTF Test Schedule



ACCOMPLISHMENTS: JGPSCE JTF is in the second year of a four and a half year program. During the past year, JGPSCE has established a firm handle on its plan of attack toward meeting its charter--manning authorizations are being filled, budgets have been established, and GYPSY ALPHA is scheduled for November 2000. Significant accomplishments are listed below.

- Promoted JGPSCE JTF and solicited support of program by briefing many high ranking military officers and civilians from all Services.

- Hosted first JGPSCE Joint Warfighter's Conference 19-20 January 2000 in Suffolk, Virginia.

- GYPSY ALPHA Initial Planning Conference was held on 5-6 April 2000 at Kirtland AFB, New Mexico.

- JGPSCE hosted it's first General Officer Steering Committee on 16 May 2000 in the Pentagon.

- JGPSCE published Program Test Plan dated 20 June 2000.

- GYPSY ALPHA Mid-Planning Conference was held on 11-12 July 2000 at Kirtland AFB, New Mexico.

- GYPSY ALPHA Final Planning Conference was held on 7 September 2000 at Kirtland AFB, New Mexico.

PLANNED ACTIVITIES: In addition to the four test events, JGPSCE is planning a host of activities necessary for the development and conduct of the program tests. They are as follows:

- General Officer Steering Committee(GOSC): JGPSCE will hold one GOSC each year, or as called by the GOSC chairman, to review progress, provide guidance, and assist in the identification of additional test resources.

- Joint Warfighting Group: Comprised of officers and enlisted personnel from operational units and command sponsors, along with other appropriate agencies. Meetings will be repeated for each field test event.

- Initial Planning Conferences: Conducted for all planned test events. Attendees will include representatives from each unit and test range participating in the test. The purpose of the conference is to develop a strawman detailed test plan.

- Mid-Planning Conferences: Conducted for all planned test events. Attendees will include representatives from each unit and test range participating in the test. The forum will be a working-level information exchange and progress review that will assist in developing a draft detailed test plan for the test activity.

- Final Planning Conferences: Conducted for all planned test events. Attendees will include representatives from each unit and test range participating in the test. The purpose of the conference is to conduct a final review of the detailed test plan.

LEGACY PRODUCTS: JGPSCE is planning legacy products in three crucial areas: Operations, Intelligence, and Acquisition. Designation of legacy sponsors will be validated by the GOSC. Various legacy products affect the following:

- Operational legacy products affect the manner in which U.S. forces prepare for and conduct war. The products apply to joint tactics, techniques, and procedures; training; planning; and actual operations.

- Intelligence legacy products affect the manner in which intelligence sources support the warfighters. Intelligence sources must be able to recognize threats to GPS users, make the commander cognizant of the threats, and characterize the threats as environmental, friendly or hostile.

- Acquisition legacy products affects the manner in which GPS systems are developed, tested, and procured. These products will address system requirements, test methodologies for evaluating GPS vulnerabilities, and standards for GPS Electronic Warfare Effects will offer up-to-date advice on GPS threats, vulnerabilities, test results and ways to guarantee GPS performance.

POINTS OF CONTACT:

Joint Test Director	Col James R. (Bob) Greenlee	(505) 846-6846 (DSN 246)
Deputy Director/ Air Force Deputy	Lt Col John (Vic) White	(505) 853-0346 (DSN 263)
Chief, Integration Division/ Navy Deputy	CDR Steve (Goat) Edson	(757) 638-6029
Chief, Requirements Division/ Army Deputy	MAJ Robert Morgan	(505) 846-1795 (DSN 246)
Chief, Assessments Division	MAJ Mike Roane	(505) 853-0090 (DSN 263)
Chief, Operations Division	Maj West (Ghost) Kasper	(505) 853-0293 (DSN 263)
Technical Advisor	Mr Dennis Lester	(505) 853-7395 (DSN 263)
Chief, Management Division	Ms Linda Surran	(505) 853-1719 (DSN 263)

Website: www.acq.osd.mil/te/programs/jte for additional information on the JT&E Program
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